PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:	WO 92/12602
H04Q 7/04, H04B 7/26	A1	(43) International Publication Date:	23 July 1992 (23.07.92)

(21) International Application Number: PCT/GB91/02290

(22) International Filing Date: 20 December 1991 (20.12.91)

(30) Priority data:
9028108.0 27 December 1990 (27.12.90) GB

(71) Applicant *(for all designated States except US)*: BRITISH TELECOMMUNICATIONS PUBLIC LIMITED COMPANY [GB/GB]; 81 Newgate Street, London EC1A 7AJ (GB).

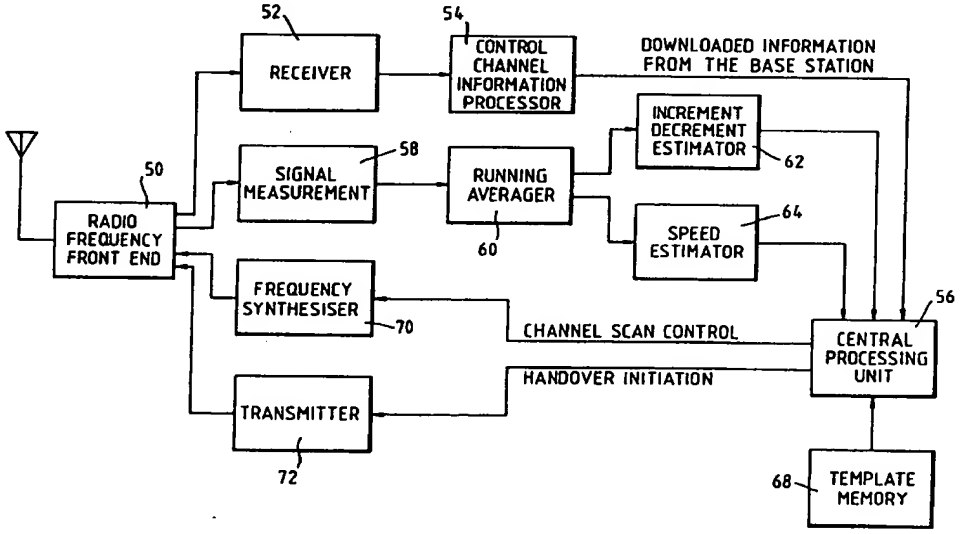
(72) Inventor; and
(75) Inventor/Applicant *(for US only)* : CHIA, Si, Tak, Stanley [GB/GB]; 50 Heathfield, Martlesham Heath, Ipswich, Suffolk IP5 7UD (GB).

(74) Agent: BUTTRICK, Richard; Intellectual Property Department, British Telecom, 151 Gower Street, London WC1E 6BA (GB).

(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB, GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent), US.

Published
With international search report.

(54) Title: MOBILE RADIO HANDOVER INITIATION DETERMINATION



(57) Abstract

An intelligent mobile radio unit is served by one of a network of macrocells and microcells. The unit is arranged to monitor, for example, the signal strength or bit error ratio of signals transmitted from each of a set of candidate base stations of cells surrounding the serving base station based on the assessment of a running average of the rise/fall in signal quality, the unit is arranged to determine from a look-up table of stored templates of conditions for handover whether a handover between base stations and between macro- and microcells is appropriate.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CS	Czechoslovakia
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GA	Gabon
GB	United Kingdom
GN	Guinea
GR	Greece
HU	Hungary
IT	Italy
JP	Japan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
LI	Liechtenstein
LK	Sri Lanka
LU	Luxembourg
MC	Monaco
MG	Madagascar
ML	Mali
MN	Mongolia
MR	Mauritania
MW	Malawi
NL	Netherlands
NO	Norway
PL	Poland
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SN	Senegal
SU	Soviet Union
TD	Chad
TG	Togo
US	United States of America

MOBILE RADIO HANDOVER INITIATION DETERMINATION

This invention relates to handover determination between cells in a cellular radio system handling communications to and from a mobile unit.

It is important that handover between cells in a cellular radio network is conducted appropriately and reliably. In mixed cell environments comprising macrocells and overlying microcells, the usability of an established communication channel with a base station could be both noise and interference limited. As far as maintaining signal quality and the limitation of the effects of interference are concerned, it is possible to use dynamic channel assignment in all cells. However, to afford an appropriate level of reliability for a mobile unit on the move it is necessary to be able to perform intercell handover both reliably and at the appropriate time.

In a cellular radio system comprising both macrocells and overlying smaller microcells, a call to or from a mobile unit within the operating area of the system is handled by a base station for each cell. Whereas, a macrocell may be of a size covering a number of streets and extending for 1 or 2 kilometres in all directions, a microcell will often be about 200 to 500 metres long and may only extend linearly along a street, within the coverage area of a macrocell.

The handover between a microcell and a macrocell is subject to special considerations. It is important for the system to be able to determine whether it is worthwhile effecting a handover of a mobile unit from a macrocell to a microcell as the latter is approached or between adjacent microcells. It may be that the mobile unit is going to enter the candidate microcell for a significant period, in which case a handover is beneficial, or relatively momentarily as the candidate microcell is crossed.

According to the present invention there is provided a handover determination system for a mobile radio network comprising a plurality of cells, each having associated with it a base station for supporting communications with a mobile unit, the system comprising:

(a) means for monitoring a quality of a signal respectively transmitted between each of a plurality of candidate base stations and the mobile unit;

(b) means for producing an indication of the rise or fall in the said quality; and

(c) control means for initiating a handover from a serving base station, supporting communications with the mobile unit to another base station, on the basis of the rise/fall in the said quality of the signals associated with the plurality of candidate base stations being monitored

Preferably, the mobile unit comprises the monitoring means and the producing means, the mobile unit further comprising signalling means for addressing the serving base station with an indication of the need for a handover to be initiated. The signalling means may be arranged to address the serving base station with an indication of the level of priority of a handover and/or with an indication of the possibility of a handover contingent upon the proceeding results of monitoring the quality of the transmitted signal. Advantageously, the monitored signal is transmitted from each mobile unit to the base station.

The monitored signal may be the received signal power. However, in digital communications systems the bit error ratio can be used.

Preferably, the control means are arranged to instruct the monitoring means to monitor a set of signals, each signal being distinctive of one of the corresponding set of base stations, the composition of the set being defined in accordance with the identity of the serving base station. In particular, each signal in the set of signals may distinguish a respective base station by the frequency of the signal.

In one particular form of the invention, the indication producing means include a quality decrement/increment estimator which is arranged to determine the rise or fall in the quality from the calculation of the running average of the indications. There may also be provided means for storing templates of changes in signal quality and/or rates of change

thereof, the control means are arranged to initiate a handover based at least partially on the recognition of a substantial match between the incoming signal and a template.

The invention also extends to a handover determination method for a mobile radio network comprising a plurality of cells, each having associated with it a base station for supporting communications with a mobile unit, the method comprising:

(a) monitoring a quality of a signal respectively transmitted between each of a plurality of candidate base stations and the mobile unit;

(b) producing an indication of the rise or fall in the said quality; and

(c) initiating a handover from a serving base station supporting communication with the mobile unit, to another base station on the basis of the rise/fall in the said quality of the signal associated with the plurality of candidate base stations being monitored.

Furthermore, the invention also extends to a mobile unit for a mobile radio system, the mobile unit comprising means for receiving a plurality of signals each respectively transmitted by one of a set of candidate base stations; means for monitoring a quality of the signal; means for producing an indication of the rise or fall in the said quality; and signalling means for transmitting to a serving base station supporting communication with the mobile unit, a signal indicating

the need for a handover to a candidate base station on the basis of the rise/fall in the said quality of the signals associated with the plurality of candidate base stations being monitored.

The rise or fall in the quality being monitored may be interpreted to derive an indication of the need for a handover based on the likelihood of the serving base station and each of the candidate base stations being able to support communication, preferably for a substantial duration which would make handover worthwhile.

The invention can be put into practice in various ways, one of which will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a block diagram of an intelligent mobile unit for use in the invention; and

Figure 2 is a block diagram of a speed estimator for use in the invention.

The embodiment of the invention includes an intelligent mobile unit which is able to monitor intensively the strength of signals transmitted from adjacent microcell base stations in addition to a serving microcell or macrocell base station. If the serving cell is a microcell which has a boundary in common with a parent macrocell, the adjacent macrocell base station is also monitored by the mobile unit.

The invention utilises an assessment of the variation in signal quality, e.g. received power level or bit error ratio, of a signal transmitted between each target microcell and possibly an adjacent macrocell, which are candidates for a handover, and the mobile unit which is served by a currently serving microcell or macrocell.

Referring to Figure 1 the intelligent mobile unit is used to monitor the signals received from the serving and target base stations as well as to transmit handover initiation commands.

The transmitted signals are relayed from a transmitter (the base station) to the receiver (mobile unit) radio frequency front end 50 to be processed by a pair of receiving circuits.

On the one hand, the received signal is passed from the radio frequency front-end 50 to a receiver unit 52 arranged to derive the control channel information from the incoming signal transmitted from the serving base station. The basic information is then applied to a control channel information processor 54. The processor 54 demodulates and decodes the control channel information for use by a central processing unit 56. The processed information is then used by the central processing unit 56 in the handover determination. This is described below.

On the other hand, the received signal from each of the serving and target base stations is also relayed from the radio frequency front end 50 to a signal

measurement unit 58 which provides a measurement of signal quality. The unit 58 may be, for example, a received signal strength indication or bit error rate counter.

A running average is then determined of the indication or count by a running averager 60. The averaging serves to smooth out transients. A determination of the trend in the signal quality is then derived by an increment/decrement estimator 62 from the averaged signal. The averaged signal is also used by a speed estimator 64 to provide an estimation of the absolute speed of the mobile unit.

The information from the control channel information processor, the increment/decrement estimator and the speed estimator is sent to the central processing unit 56. The central processing unit uses the control channel information downloaded from the serving base station to determine the monitoring algorithm to be adopted according to the type and location of the cells in and around which the mobile unit is located.

The trend in signal quality, the speed estimation, a look-up table 68 of signal quality templates and the control channel information downloaded from the base station, are used to determine whether a handover is appropriate and, if so, whether it should be on an intracell or an intercell basis.

The central processing unit 56 controls a frequency synthesiser 70 associated with the radio frequency front end to scan the channel set of frequencies used by the serving and target base stations in order to perform signal level measurements, and to control the transmission and reception of signals.

The processing unit also controls the operation of a transmitter 72 arranged to transmit handover initiation information via the radio frequency front end 50, to the serving base station.

Each base station in a cellular radio system according to the invention transmits a signal identifying the base station specifically. Each time the mobile unit is handed over from, say, a macrocell to a microcell or between microcells, a new set of carrier frequencies to be monitored and a new algorithm for addressing adjacent candidate base stations, in order that their signal levels can be monitored is downloaded from the newly appointed serving base station. Each algorithm sets out the frequencies to be monitored and the look-up table of signal level increment/decrement gradient templates. Each template is associated with a mobile unit moving at a particular speed towards or away from the various monitored base stations.

As will be shown below, in many cases the detection of a rise or fall in signal power level received from a particular base station is sufficient on which to base a handover decision in conjunction

with the conventional criteria determining handover, i.e. signal level thresholds and hysteresis, the latter causing a delay after the threshold is passed to ensure that the change in signal level is not simply a momentary phenomenon. However, there are also situations in which it is necessary to know the rate of change of signal levels in relation to the speed of the mobile unit in order to determine whether a handover is appropriate or not.

In our co-pending British Patent Application No. 9016341.1 filed on 25th July 1990, there is described a speed estimator which can be adapted to provide an assessment of the speed of a mobile unit in a cellular radio system based on filtered received signals. As also described in that application, the speed estimator can be adapted to provide an increment/decrement indication from the running average of vehicle speed.

Such a speed estimator is shown in Figure 2. It consists of a received signal strength indicator circuit 10 which outputs a voltage level signal proportional to the received signal power to an analogue-to-digital convertor 12 (ADC). The sampling rate of the ADC 12 is determined by the averaging window duration to the highest required speed. The highest speed to be determined is 40 m/s and as 100 samples are required to determine a running average, a sampling rate of 1.7kHz is required (i.e. 100 samples per 60 ms). A rounded sampling rate of 2kHz may be applied.

In Figure 2, the digital data from the ADC 12 is fed in parallel to a number of speed detection modules comprising averaging units 14 to 20 each with an averaging window of a different duration (1, n1, n2, n3, etc.). The output from each of the averaging windows is input via an average-buffer 26 into a variance calculator 28 before being fed to speed decision logic 30.

The averaging unit 14 with a window of 1 sample is equivalent to the instantaneous signal level. A running average can be calculated at each clock cycle where a new sample value is fed in parallel to all the averaging units 14 to 22. The estimator will not be operational until all the averaging units and the buffers 26 are filled with samples. Thus, the time delay for the system to be operational is equivalent to the size of the largest averaging window (n3) plus the average-buffer-size. The size of the buffer 26 is usually small, eg 10 samples. Thus, the majority of the time delay is taken up with filling the largest averaging unit n3. For instance, if the largest averaging unit n3 is for averaging over 3 seconds, then the system will have a time delay of approximately 3 seconds plus a short time to load the buffer 26.

This speed estimator can be implemented in hardware and/or software and the number of speeds can be estimated by implementing a multiple number of basic speed detection modules.

The increment/decrement heading estimator is an extension of the speed estimator. The values stored in the average-buffers could be easily manipulated by software to return either a majority logic vote for the underlying trend or the slope of the running average.

The mobile unit is able to base a handover decision on an assessment of mobile unit received signal power level indications from 2 or more adjacent candidate base stations. Alternatively, the mobile unit may be arranged to alert the current serving base station of the desirability of a handover. It will be appreciated by the skilled person that any suitable assessment of signal quality could be used in place of or in combination with received signal levels. As one example, the bit error ratio could be used when a digital information signal is transmitted by the base stations. As another example signal delay testing (timing advance) can be used to determine the distance of the mobile unit from a base station. Whatever assessment is adopted, the result is used in a determination of the mobile unit heading relative to each of the candidate base stations.

When the mobile unit is monitoring signals transmitted from candidate base stations, various scenarios for a given serving base station will be used to determine the appropriateness of handover. These scenarios will form a set of condition templates, the constituents of which will be specific to a particular serving base station. However, there are various predictable scenarios which can be defined in general terms :

1. If a mobile unit is served by a microcell and the signal levels from both the serving microcell base station and candidate microcell base station are decreasing as indicated by the increment/decrement estimator this implies that the mobile unit is leaving the serving microcell via a side road and handover from the serving microcell to the parent macrocell should be initiated straight away.

2. By contrast, if a mobile unit is served by the macrocell and the mobile unit detects the signal levels from 2 adjacent microcell base stations (established, for example, in line along the same street) are increasing simultaneously, this indicates that the mobile unit is approaching an area served by microcells. In this situation a handover operation may potentially be required. However, only a standby flag is set to warn the system including the current serving and the target base stations or to raise the priority of access for the mobile unit to the microcell system. No handover execution is effected until further information is obtained.

3. After the above warning flag has been set, if the signal levels monitored by the mobile unit change from both increasing to one increasing while the other is decreasing at a pre-defined rate, this implies that the mobile unit is within the service area of one of the microcells. Handover from the serving macrocell to the

microcell in which the mobile unit is adjudged to be, i.e. as identified by the increasing signal level, should be executed immediately. The success of the handover will only depend on the availability of a channel in the microcell base station.

4. When a mobile unit is travelling within the area served by the microcell, the previous scenario also serves as a confirmation that the mobile unit remains within it and that the handover to the microcell was appropriate.

5. If when the mobile unit is served by the microcell, it fails to locate another microcell base station with increasing signal levels, then a handover to a macrocell must be initiated. This will occur when a mobile unit has entered the outer cell of a microcell sub-network and is about to exit from it. The outer cell is typically constituted by the last microcell in a street.

6. However, when the mobile unit is in a macrocell and the signal level from microcell base station is on the increase, this indicates that the mobile unit is approaching that microcell. In this situation a handover from the macrocell to the candidate microcell should be initiated. It must be noted that in this situation the rate of increase in relation to the vehicle speed must also be assessed. This is to distinguish proper entry into a microcell from a situation where the mobile unit is merely crossing the candidate

microcell. If the rate of increase detected is steeper than the limit represented by normal approach, a delay factor should be built-in before initiating the handover. This will allow handover only if the signal level continues to increase during the delay, indicating that the mobile unit has turned into the microcell rather than subsequently crossed it.

7. For a 3 microcell merging situation if the signal levels of 2 microcell base stations are decreasing and the third one if increasing, this implies that the mobile unit is leaving the microcell sub-network extending along one road and is likely to join the microcell sub-network extending along a branching or parallel road.

The implementation of the proposed handover processing techniques requires an intelligent mobile radio receiver which has the capabilities of processing running averages and of monitoring the signal level variations. In addition it must also be able to store all the pre-defined handover condition templates and the information downloaded from a base station after handover has been effected, and the information containing instructions on the monitoring carrier frequencies for adjacent candidate base stations which are to be monitored while the mobile unit is in that serving cell.

CLAIMS

1. A handover determination system for a mobile radio network comprising a plurality of cells, each having associated with it a base station for supporting communications with a mobile unit, the system comprising:

means (14,16,18,20) for monitoring a quality of a signal respectively transmitted between each of a plurality of candidate base stations and the mobile unit;

means (30) for producing an indication of the rise or fall in the said quality; and

control means (56) for initiating a handover from a serving base station, supporting communications with the mobile unit, to another base station, the initiation being based on the rise/fall in the said quality of the signals associated with the plurality of candidate base stations being monitored.

2. A system as claimed in claim 1, in which the mobile unit comprises the monitoring means and the producing means, the mobile unit further comprising signalling means (50) for addressing the serving base station with an indication of the need for a handover to be initiated.

3. A system as claimed in claim 2, in which the signalling means are arranged to address the serving base station with an indication of the level of priority of a handover and/or with an indication of the possibility of a handover contingent upon the proceeding results of monitoring the quality of the transmitted signal.

4. A system as claimed in any of claims 1 to 3, in which the monitored signal is transmitted from each mobile unit to the base station.

5. A system as claimed in any of claims 1 to 4, in which the monitored quality of the signal is the received signal power or the bit error ratio.

6. A system as claimed in any of claims 1 to 5, in which the control means are arranged to instruct the monitoring means to monitor a set of signals, each signal being distinctive of one of a corresponding set of candidate base stations, the composition of the set of candidate base stations being defined in accordance with the identity of the serving base station.

7. A system as claimed in claim 6, in which each signal in the set of signals distinguishes a respective base station by the frequency of the signal.

8. A system as claimed in any of claims 1 to 7, in which the indication producing means include a quality decrement/increment estimator (62) which is arranged to determine the rise or fall in the quality from the calculation of the running average of the indications.

9. A system as claimed in any of claims 1 to 8, including means (68) storing a set of templates of changes in signal quality and/or rates thereof, the control means being arranged to initiate a handover based at least partially on the recognition of a substantial match between the incoming signal and a template.

10. A handover determination method for a mobile radio network comprising a plurality of cells, each having associated with it a base station for supporting communications with a mobile unit, the method comprising:

monitoring a quality of a signal respectively transmitted between each of a plurality of candidate base stations and the mobile unit;

producing an indication of the rise or fall in the said quality; and

initiating a handover from a serving base station, supporting communication with the mobile unit, to another base station, the initiation being based on the rise/fall in the said quality of the signal associated with the plurality of candidate base stations being monitored.

11. A method as claimed in claim 10 in which the monitoring of the said quality and producing the said indication is conducted by the mobile unit, the method

further including addressing the serving base station from the mobile unit with an indication of the need for a handover to be initiated.

12. A method as claimed in claim 11 in which the mobile unit addresses the base station with an indication of the level of priority of a handover and/or with an indication of the possibility of a handover contingent upon proceeding results of monitoring the quality of the transmitted signal.

13. A method as claimed in any of claims 10 to 12 in which the monitored signal is processed by the mobile unit.

14. A method as claimed in any of claims 10 to 13 in which the monitored quality is the received signal power or the bit error ratio.

15. A method as claimed in any of claims 10 to 14, including monitoring a set of signals, each signal being distinctive of one of a corresponding set of candidate base stations, the composition of the set of candidate base stations being defined in accordance with the identity of the serving base station.

16. A method as claimed in claim 15 in which each signal in the set of signals distinguishes a respective base station by the carrier frequency of the signal.

17. A method as claimed in any of claims 10 to 16, including recognising a set of unique template conditions for joining, leaving and/or staying within a

microcell based on interpretation of the rise/fall in signal quality, the initiation of a handover being at least partially determined on the basis of a substantial match between an incoming signal and a template.

18. A mobile unit for a mobile radio system, the mobile unit comprising means (50) for receiving a plurality of signals each respectively transmitted by one of a set of candidate base stations; means (14,16,18,20) for monitoring the quality of the signal; means (62) for producing an indication of the rise or fall in the said quality; and signalling means (50) for transmitting to a serving base station, supporting communication with the mobile unit, a signal indicating the need for a handover to a candidate base station on the basis of the rise/fall in the said quality of the signals associated with the plurality of candidate base stations being monitored.

19. A mobile unit as claimed in claim 18 in which the signalling means are arranged to address the base station with an indication of the level of priority of a handover and/or with an indication of the level of priority of a handover contingent upon proceeding results of monitoring the quality of the transmitted signal.

20. A mobile unit as claimed in claim 18 or 19 in which the monitoring means are arranged to monitor received signal power or bit error ratio.

21. A mobile unit as claimed in any of claims 18 to 20 in which the indication producing means include a quality increment/decrement estimator (62) which is arranged to determine the rise/fall in the quality from the calculation of a running average of the indications.

22. A mobile unit as claimed in any of claims 18 to 21 including means (68) storing a set of templates of changes in signal quality and/or rates thereof, the signalling means being at least partially responsive to a substantial match of a template with an incoming signal for transmitting to the serving base station the indication of the need for a handover.

Fig. 1.

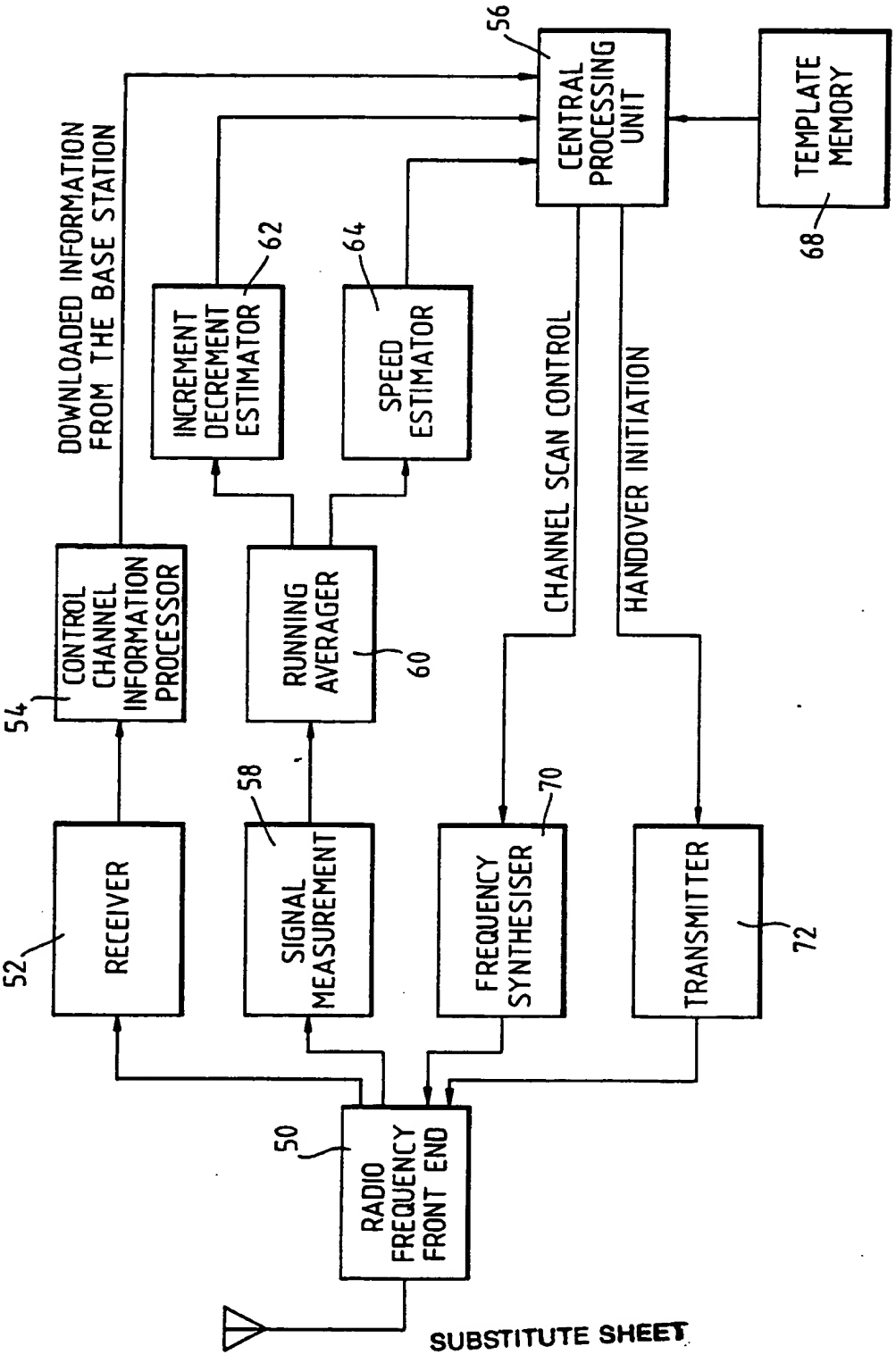
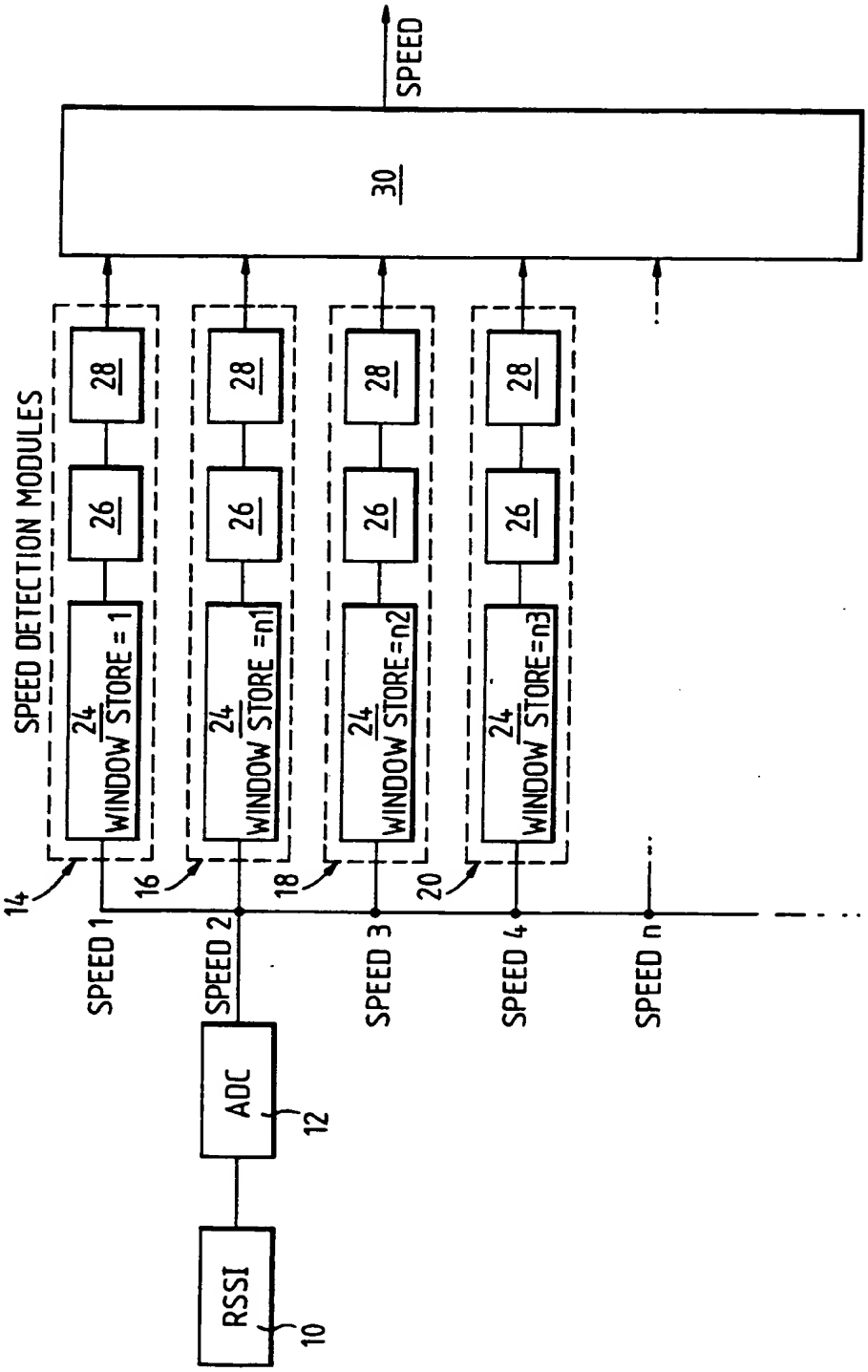

CENTRAL PROCESSING UNIT
56
TEMPLATE MEMORY
68
DOWNLOADED INFORMATION FROM THE BASE STATION
INCREMENT DECREMENT ESTIMATOR
62
SPEED ESTIMATOR
64
CHANNEL SCAN CONTROL
HANDOVER INITIATION
CONTROL CHANNEL INFORMATION PROCESSOR
54
RUNNING AVERAGER
60
RECEIVER
52
SIGNAL MEASUREMENT
58
FREQUENCY SYNTHESISER
70
TRANSMITTER
72
RADIO FREQUENCY FRONT END
50

Fig. 2.


SPEED
30
SPEED DETECTION MODULES
28
26
24
WINDOW STORE = 1
WINDOW STORE =n1
WINDOW STORE=n2
WINDOW STORE=n3
14
16
18
20
SPEED 1
SPEED 2
SPEED 3
SPEED 4
SPEED n
ADC
12
RSSI
10

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 91/02290

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 H04Q7/04; H04B7/26

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	H04Q

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document,[11] with indication, where appropriate, of the relevant passages[12]	Relevant to Claim No.[13]
X	EP,A,0 241 954 (PHILIPS) 21 October 1987	1-5,8, 10-15, 18,20,21
Y	see column 4, line 35 - column 5, line 17 see column 5, line 45 - line 58 see column 6, line 32 - line 44 see column 7, line 32 - column 9, line 35	6,9,17, 22
Y	FR,A,2 621 435 (SETSYS) 7 April 1989 see page 1, line 28 - page 2, line 25 see page 4, line 34 - page 5, line 23	6,9,17, 22

-/--

° Special categories of cited documents :[10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
30 MARCH 1992	09 APR 1992
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	GERLING J.C.J.

1

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
X	EP,A,0 236 194 (SOCIETE D'ETUDES ET DE CONSTRUCTIONS ELECTRONIQUES) 9 September 1987 see page 2, line 14 - page 3, line 9 see page 3, line 18 - page 4, line 24 see page 5, line 22 - page 6, line 7	1-3,5-7, 10-16, 18,20
X	US,A,4 829 519 (SCOTTON ET AL) 9 May 1989 see column 1, line 65 - column 2, line 27 see column 3, line 32 - column 4, line 3 see column 5, line 29 - line 37 see column 5, line 56 - line 60 see column 6, line 1 - line 7	1-3,5-8, 10-16, 18,20,21
X	EP,A,0 037 070 (SIEMENS) 7 October 1981 see page 3, line 9 - page 4, line 5 see page 4, line 20 - page 6, line 13	1,5,8, 10,14
X,P	WO,A,9 119 403 (BRITISH TELECOM.) 12 December 1991 see page 1, line 3 - line 30 see page 4, line 14 - page 5, line 3 see page 6, line 1 - page 7, line 8	1-6,8, 10-15, 18-21
X,P	EP,A,0 455 614 (TELEFONAKTIEBOLAGET L M ERICSSON) 6 November 1991 see page 2, line 36 - line 53 see page 4, line 17 - line 23	1-5,8, 10-13, 18-21
X,P	EP,A,0 454 638 (TELEFONAKTIEBOLAGET L M ERICSSON) 30 October 1991 see column 1, line 26 - line 49 see column 3, line 5 - line 25 see column 3, line 46 - column 5, line 22	1-5, 9-14, 17-20,22
E	WO,A,9 202 105 (BRITISH TELECOM.) 6 February 1992 see page 4, line 1 - page 5, line 25 see page 7, line 20 - page 8, line 20 see page 8, line 30 - page 9, line 11 see page 10, line 36 - page 11, line 20	1-6, 8-15, 17-22

-/--

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	38TH IEEE VEHICULAR TECHNOLOGY CONFERENCE June 1988, PHILADELPHIA (US) pages 340 - 343; D. MUNOZ-RODRIGUEZ ET AL: 'FORECASTING TECHNIQUES IN CALL HAND-OFFS FOR CELLULAR COMMUNICATION' see page 340, left column, line 1 - line 24 see page 342, right column, line 13 - page 343, left column, line 7 ---	1-3,5, 10-14, 18-21
A	40TH IEEE VEHICULAR TECHNOLOGY CONFERENCE 6 May 1990, ORLANDO (US) pages 276 - 281; S T S CHIA ET AL: 'HANDOVER CRITERIA FOR CITY MICROCELLULAR RADIO SYSTEMS' ---	

ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. GB 9102290
SA 54810

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information. 30/03/92

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
EP-A-0241954	21-10-87	DE-A-	3607687	10-09-87
		AU-B-	593619	15-02-90
		AU-A-	6978287	10-09-87
		CA-A-	1272816	14-08-90
		JP-A-	62213435	19-09-87
		US-A-	4765753	23-08-88
FR-A-2621435	07-04-89	None		
EP-A-0236194	09-09-87	FR-A-	2594276	14-08-87
US-A-4829519	09-05-89	None		
EP-A-0037070	07-10-81	DE-A-	3012484	08-10-81
		AT-T-	11090	15-01-85
		AU-B-	543725	02-05-85
		AU-A-	6889881	08-10-81
		JP-A-	56152345	25-11-81
WO-A-9119403	12-12-91	None		
EP-A-0455614	06-11-91	SE-B-	466082	09-12-91
		AU-A-	7749191	27-11-91
		SE-A-	9001590	04-11-91
		WO-A-	9117608	14-11-91
EP-A-0454638	30-10-91	SE-B-	466081	09-12-91
		AU-A-	7562991	11-11-91
		WO-A-	9116772	31-10-91
WO-A-9202105	06-02-92	None		

EPO FORM P0479

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82